

FIVE-YEAR REVIEW REPORT

THIRD FIVE-YEAR REVIEW REPORT For the CHEROKEE COUNTY SUPERFUND SITE CHEROKEE COUNTY, KANSAS

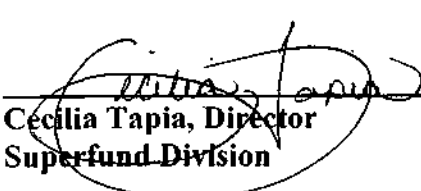
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SUPERFUND RECORDS

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ATTACHMENTS

FIGURE 1	CHEROKEE COUNTY, KANSAS SITE MAP
FIGURE 2	TRI-STATE WATERSHED MAP

TABLE 1	SITE CHRONOLOGY
TABLE 2	LISTING OF DOCUMENTS REVIEWED

APPENDIX 1	FIVE-YEAR REVIEW SUMMARY FORM
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I. INTRODUCTION

This report documents the third five-year review of all completed operable units of the Cherokee County Superfund Site in Cherokee County, Kansas (Site). The first five-year review was completed in September 1995, and exclusively addressed operable unit (OU) #01, Galena Alternate Water Supply. The second five-year review was completed in September 2000, and it encompassed the entire Site. The site consists of seven operable units and subsites that are discussed in detail in the following sections. Both of the prior reviews, and this review, have been conducted by the U.S. Environmental Protection Agency (EPA) as the lead agency with support from the Kansas Department of Health and Environment (KDHE), the support agency. A summary of the findings and issues resulting from this review are provided in Attachment 1.

The purpose of the five-year review is to determine the continued adequacy of remedial response actions undertaken at the Site to protect human health, welfare, and the environment. Section 121 (c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and Section 300.430(f)(4)(ii) of the National Oil and Hazardous Substances Pollution Contingency Plan require that periodic (at least once every five years) reviews be conducted for sites where hazardous substances, pollutants, or contaminants remain above levels that allow for unlimited use or unrestricted exposure following the completion of all remedial actions for a site. The reviews are to be completed within five years of initiation of the first remedial action at a site. Remedial activities at the Cherokee County site began in September 1989 at OU-1.

This five-year review is supported by several field visits at all operable units of the Site to observe general conditions and the status of ongoing and completed remedial actions following the issuance of the last five-year review in 2000. Site visits have been conducted by the following individuals in support of this third five-year review: Gene Gunn, Dave Drake, and Jason Gunter of EPA Region 7; Leo Henning, Bob Angelo, Rob Weber, Ashley Allen, and Murray Balk of KDHE; John Miesner of the U.S. Fish and Wildlife Service (USFWS), and Tom Morey formerly with KDHE. The USFWS is an additional supporting organization for this five-year review, in addition to the U.S. Geological Survey (USGS) and the Agency for Toxic Substances and Disease Registry (ATSDR).

II. SITE CHRONOLOGY

The site was listed on the National Priorities List in September 1983, in response to a host of mining related problems that were observed following the cessation of active lead-zinc mining in 1970. Pre-NPL investigations began in the early 1980s and focused on many diverse issues such as health concerns related to elevated blood lead levels, silicosis, an increased risk for certain cancers and other illnesses, engineering stability problems stemming from ground and road collapses, impacted streams and surface water bodies as evidenced by acid mine drainage and ecological impacts, and the presence of large volumes of mine tailings at the surface over several square miles.

The Site was arranged into geographic subsites and work process oriented operable units. Impacted drinking water sources were addressed initially followed by residential and surficial mining

wastes with human health impacts and lastly, mining wastes with a predominant ecological focus. Table 1 depicts the major site chronology events.

III. BACKGROUND

The Cherokee County Superfund Site represents the Kansas portion of the Tri-State Mining District (District) and is shown on Figure 1. The District encompasses approximately 2,500 square miles in Oklahoma, Kansas, and Missouri, and was formerly one of the richest lead and zinc ore producing deposits in the world. The Kansas portion of the District lies within the extreme southeast corner of the state.

Because of the large geographic area of mining in Kansas, the 115 square mile Site has been divided into the following seven subsites: Galena; Baxter Springs; Treece; Badger; Lawton; Waco; and Crestline. These seven subsites encompass most of the area where mining occurred within the Site, and where physical surface disturbances were evident.

The District is characterized by a variety of mine waste features that include the following: large piles of sand- and gravel-sized mill tailings locally known as "chat"; piles of overburden bedrock materials locally known as "bullrock"; tailings impoundments and ponds that contain accumulations of silt- and clay-sized flotation tailings; open and collapsed mine shafts, sometimes filled with water; and subsidence features. The mine waste areas contain sparse to no vegetation. Local stream systems also contain mining wastes and mining-impacted sediments and surface water. Residential areas are adjacent to mine waste accumulations in some areas or have suffered historic impacts as a result of smelting. Lead and zinc are found in mining wastes and soils at maximum concentrations of several thousand parts per million (ppm), while cadmium is typically found at levels less than 500 ppm. The District and associated watersheds are shown on Figure 2.

Lead and zinc mining began in the middle 1800s and continued for over a century in the District; the final mining activities ceased in 1970. Sphalerite (zinc sulfide) and galena (lead sulfide) were the principle mined ores and several other metal sulfides were found in association with the economic ores. The mining activities changed the hydrology of the area by creating a labyrinth of underground voids and many open conduits. These features facilitate surface subsidence and collapse as well as enhanced flow of mineralized groundwater in the subsurface. Surficial mining wastes also leach metals into the groundwater system and surface water bodies. The normal surface and subsurface flow characteristics have been modified by past mining activities, and since much of the surface vegetation is impacted or absent, there is increased infiltration of surface water into the shallow groundwater system and erosion of mining wastes into surface water bodies. During the active mining years, water was continually pumped out of the mines because the ore was predominantly located in the saturated zone of the same bedrock formations that contain the area's shallow aquifer. When mining ceased, the mines re-filled with water as a result of natural groundwater recharge and surface water inflow through mine shafts and subsidence areas. The upper aquifer is now contaminated with metals and is acidic in some areas. Acid mine drainage is prevalent in portions of the District.

The primary sources of contamination at the Site are the residual metal sulfides in the abandoned mine workings, chat piles, and tailing impoundments in addition to historic impacts from smelting operations. Upon exposure to the atmosphere, metal sulfides can become oxidized and mobilize as dissolved compounds which increase the acidity of surface water and groundwater. The resulting metal-laden acidic water, referred to as acid mine drainage, can further leach metals from bedrock, contaminate groundwater, and fill mine shafts and subsidence features. The acid mine drainage can also surface through springs and combine with metals-laden surface water runoff to ultimately contaminate rivers, creeks, and lakes. The shallow aquifer is impacted by metals constituents as a result of past mining practices.

The seven subsites of the Site are encompassed by seven operable units in order to facilitate remedial processes. An operable unit may contain more than one subsite and a subsite may contain multiple operable units. The relationship between the subsites and operable units at the Cherokee County site is provided below:

OU-1, Galena Alternate Water Supply, contained within the Galena subsite;

OU-2, Spring River Basin, not associated with a subsite, all subsites drain to the Spring River basin with the exception of the Treece subsite;

OU-3, Baxter Springs subsite;

OU-4, Treece subsite;

OU-5, Galena Groundwater/Surface Water, contained within the Galena subsite;

OU-6, Badger, Lawton, Waco, and Crestline subsites; and

OU-7, Galena Residential Soils, contained within the Galena subsite.

IV. REMEDIAL ACTIONS

Several response actions have been completed at the Site and many operable units are in different phases of the Superfund process. The following information summarizes the current status and completed response actions for each operable unit (OU) at the site.

OU-1, Galena Alternate Water Supply

This OU is in the operation and maintenance (O&M) phase. All EPA Superfund work has been completed as a fund-lead effort and the remedy is in place under long term O&M by the state of Kansas. Initial response actions included the provision of bottled water and water softener units as removal actions prior to the completion of a permanent alternate water supply system as the final remedial action. A rural water district was formed, water supply wells were installed, support buildings

constructed, and the new source of drinking water was provided to 400 residences in rural areas near the community of Galena, Kansas. Nearly 1,500 people were provided with a permanent source of clean drinking water and over 57 miles of pipelines were placed during the construction effort. The upper aquifer in this area is impacted by metals contaminants (lead, zinc, and cadmium) from mining operations. Private, shallow, water supply wells were affected; municipal wells for the city of Galena are constructed in a lower pristine, potable aquifer and are not impacted by past mining activities. The source of water for the rural water district is also the lower potable aquifer. The rural water district has expanded by 86 new users, for a total of 486 residential hookups, since completion of the remedial action in 1994. The Record of Decision (ROD) was issued in 1989 and the O&M phase began in 1995. There are no known problems with the operation of the rural water district.

OU-2, Spring River Basin

This OU is currently in the characterization phase. Surface water and sediment characterization data were collected by the USGS, on behalf of the USFWS, in 2004 and 2005. The pending results of this effort are planned for release in late 2005 and early 2006 and they will provide base-line characterization data for OU-2. Additionally, the EPA is tentatively planning . the collection of additional characterization and ecological risk data throughout the reach of the Spring River in Missouri, Kansas, and Oklahoma as a multi-organizational, coordinated effort.

All of the Cherokee County subsites drain to the Spring River basin, with the exception of the Treece subsite which flows to the Tar Creek drainage basin. Since separate response actions are planned or completed for each contributing subsite, any potential remedy for the Spring River would likely occur after the completion of remedies in mine waste areas contributing to the basin; however, selected feeder streams to the Spring River could be addressed after the upgradient contributing mining wastes in the upper reaches of these lesser streams are addressed. The Spring River also receives mine waste impacts from upgradient sources in the state of Missouri and response actions for those sources are being planned by the EPA and the state Missouri as part of the Oronogo-Duenweg Mining Belt Superfund Site in Jasper County, Missouri. Ultimate cleanup actions in the Spring River are thus somewhat dependent upon actions completed in the upstream state of Missouri. It is anticipated that potentially responsible parties (PRPs) will contribute to, or possibly conduct, some of the future remedial work in the Spring River basin.

OU-3, Baxter Springs subsite

This OU is currently in the O&M phase. Response actions at this operable unit were conducted by PRPs under a Consent Decree signed in 1999 and include residential and surficial mine waste components. All remedial work was complete in 2004.

The residential aspect of the response action included sampling and remediation, as necessary, of residential soils from properties impacted by mining activities. Mining related activities in the Baxter Springs area consist of the importation of mining wastes from nearby waste accumulations for residential purposes (landscaping, fill material, driveway material, etc.) as well as erosion of wastes

from these areas. Wastes also migrate into stream systems and may be transported to residential areas near streams during flood events. Mining wastes are prevalent in the western areas of the Baxter Springs community; thus, most of the residential effort was targeted in this area. Properties with lead values exceeding 800 ppm lead or 75 ppm cadmium were excavated until lead and cadmium levels were less than 500 and 25 ppm, respectively, or until a maximum excavation depth of one foot was achieved. Properties were backfilled with clean native soils and re-vegetated. The same criteria were utilized for residential work at other OUs of the Site. A total of 441 properties were sampled and 46 yards were remediated at the Baxter Springs subsite.

The mine waste cleanup portion included the removal of wastes from minor streams and drainages, draining and capping tailings impoundments, grading, consolidating, and capping chat piles followed by re-vegetation of all disturbed areas. The re-vegetation seed mixture consisted of tall, warm season, native grasses. The mine waste cleanup addressed mine waste accumulations that contributed major loadings to surface water bodies. Approximately 160 acres of mining wastes were remediated at the Baxter Springs subsite. Some surficial accumulations of mining wastes were not addressed by the remedy because they were deemed to not be significant contributors to the degradation to surface water.

OU-4, Treece Subsite

The residential work at this OU was completed by PRPs under the same 1999 Consent Decree as the OU-3 work and is in the O&M phase. A total of 148 properties were tested and 41 yards were remediated. The residential cleanup was completed in 2000.

The response action consisted of a residential lead cleanup for the community of Treece, Kansas. The town of Treece is located near several former mining areas and wastes from these areas were transported to residential locations for a variety of purposes such as driveway construction, landscaping, fill material, and alley/road construction. The remediation consisted of removing up to one foot of metals (lead, cadmium, and zinc) impacted soils from residential yards followed by placement of clean backfill soils and re-vegetation. Additional components included a well search to determine if any residents in the Treece area were consuming contaminated water from private water wells followed by the abandonment of these wells when identified. Any deep wells providing a conduit to transmit contaminated water from the upper aquifer to the lower pristine aquifer were to be abandoned under the Treece cleanup. Well search activities did not identify any deep wells transmitting contaminants to lower clean aquifers or any residents consuming impacted groundwater. The town of Treece is served by a municipal water system that is regulated by the state and it provides safe drinking water. Non-residential mining wastes at the Treece subsite were not addressed by the residential remedy.

OU-5, Galena Groundwater/Surface Water

This OU is in the O&M phase with all EPA Superfund work completed as a fund-lead response. Long-term O&M is being conducted by the state of Kansas. The remedy was completed in 1996 and transitioned to the O&M phase in 1997. The response action consisted of a mine waste

cleanup of approximately 900 acres of non-residential land surrounding the community of Galena, Kansas. Mining wastes were segregated and wastes less than 1,000 ppm lead were placed at the surface with more impacted wastes placed at depth or used as fill material for open dry shafts. Low concentration wastes or bull rock were used to fill shafts that were water-filled. In general, large mine waste accumulations were re-graded and re-distributed, local drainages were enhanced by rip rap, new engineered drainages were created (geotextile lined with rip rap), open mine shafts and collapse features were filled with wastes, and the surface was re-vegetated with a mixture of warm, tall-season, native prairie grasses. Selected areas were re-vegetated following a series of inspections after completion of the remedy. The ROD was issued in 1989.

Some amount of re-grading and re-seeding will be required as an expected long term maintenance item over time. Additionally, a small number of filled shafts and collapses have partially re-opened and may require re-filling in the future. The KDHE has expressed concern over the extent and cost of the ongoing maintenance for this completed remedy. The O&M program is currently being conducted by KDHE and is being evaluated in terms of scope and cost in relation to historic expectations. The primary problem areas are steeply sloped locations, highly acidic areas, and locations with insufficient organic materials that are difficult to re-vegetate or maintain an adequate stand of vegetation. These areas are approximately less than 200 acres in size and may require future additional remedial repair work consisting of the addition of terraces, reduced slope/grade, and enhanced soil and vegetative covers. The KDHE is currently evaluating the merits of remedy enhancement at this OU.

A three year follow-up study of the Galena subsite, conducted by the Kansas Biological Survey at the University of Kansas, was completed in 2003. This study evaluated the effectiveness of the OU-5 remedy and concluded that some ecological gains occurred. The study assessed the quality of surface water, sediments, and biological communities in the drainage area of the OU-5 mine waste cleanup action and contrasted these findings with earlier pre-cleanup data.

OU-6, Badger, Lawton, Waco, and Crestline subsites

This OU is currently in the remedial design/remedial action (RD/RA) negotiation phase with PRPs. The historic remedial investigation/feasibility study (RI/FS) process was conducted by the PRPs under an Administrative Order on Consent (AOC) issued in 1998. The RI/FS was completed in 2004 under the AOC and a ROD was issued for the cleanup in 2004. The ongoing RD/RA negotiations are expected to be complete in 2005 and result in two Consent Decrees, one for the Waco subsite and one for the Crestline subsite. The Badger and Lawton RD/RA processes will be conducted as EPA fund-lead actions.

OU-7, Galena Residential Soils

This OU is in the O&M phase and consisted of a residential cleanup action using the same criteria as discussed above for OU-3 and OU-4. The presence of a smelter in the town of Galena was responsible for a much larger residential lead problem than at the other subsites due to the wind dispersion of smelter emissions over a large area. More than 1,500 properties were sampled in the

Galena area and over 700 residential properties were remediated. This work was conducted as an EPA fund-lead effort under a 1996 ROD and was complete by 2001.

A follow-up blood lead study was conducted by the KDHE, the local Cherokee County Health Department, and the ATSDR in the community of Galena. The study was released in 2004 and illustrated the benefits of the completed residential cleanup by contrasting the results to an earlier ATSDR blood-lead study conducted prior to the residential work. The geometric mean of blood lead levels in Galena children under six years of age decreased from 4.13 ug/dl to 2.29 ug/dl following the residential clean-up (44.6 percent reduction). The overall United States geometric mean of blood lead levels in children under six years of age in 1999 to 2000 was 2.2 ug/dl.

Certain institutional controls activities were also implemented in Galena, as well as the other subsites, by KDHE and the Cherokee County Health Department. The effort included the following components: health education regarding all aspects of lead exposure; blood lead testing; physician education on the awareness and symptoms of lead poisoning; in-home lead assessments performed by nurses from the county health department; provision of a high efficiency particulate vacuum upon request by county residents; and quarterly reporting of all aspects of the institutional controls program.

It should be noted that the ultimate institutional controls program for each OU at the Site includes other elements such as restrictions on the use of chat mining wastes, land use controls, building permits, and testing requirements for development in mining impacted areas. All elements of the county wide institutional controls program have not yet been implemented.

V. PROGRESS SINCE LAST FIVE-YEAR REVIEW

Progress since the last five-year review conducted in 2000 is described below on an operable unit basis.

OU-1, Galena Alternate Water Supply: An additional 34 homes have been added to the system since the last review for a total of 486 hookups. This OU remains in long-term O&M.

OU-2, Spring River Basin: Characterization work has been conducted on the Spring River and its tributaries in addition to Empire Lake. Samples were collected in 2004 and 2005 and the riverine and sediment study reports are scheduled for release in late 2005. A summary report is planned for release in early 2006. Moreover, a multistate, multi-organizational, characterization effort is being planned in order to further characterize the ecological, surface water, groundwater, and sediment conditions throughout the Spring River basin.

OU-3, Baxter Springs subsite: The RD was completed and the RA fully implemented by PRPs. The subsite has transitioned to the O&M phase and early results indicate environmental gains resulting from the completed cleanup action.

OU-4, Treece subsite: The residential RA was completed by PRPs and transitioned to the O&M phase. The state of Oklahoma and EPA Region 6 have begun site characterization activities in the Tar Creek drainage basin and a multi-state, multi-organizational, effort is underway to characterize the ecological, surface water, groundwater, and sediment conditions throughout the Tar Creek basin.

OU-5, Galena Groundwater/Surface Water: The KDHE began conducting repair and maintenance activities for the completed remedy and is in the process of assessing the projected extent and scope of repairs in the future, in addition to possible recommendations for remedy enhancement. The KDHE has spent \$162,804 on O&M activities (\$23,058 labor and \$139,746 contractual) at OU-5 since the last five-year review. Additionally, the KDHE has begun assessment of the former smelter grounds (approximately 60 acres) that were omitted from the original mine waste clean-up. Moreover, the KDHE began a program of assessing, ranking, and filling a select number of open mine shafts at the Site on an annual basis. Over 30 mine shafts have been filled to date.

OU-6, Badger, Lawton, Waco, and Crestline subsites: The RI/FS was completed by PRPs and the terms of the AOC satisfied. A ROD was issued and RD/RA Consent Decree negotiations are ongoing.

OU-7, Galena Residential Soils: The fund-lead RA was completed and the OU transitioned to the O&M phase. The ATSDR completed a follow-up blood-lead study demonstrating the benefits of the cleanup for the local population. Select institutional controls were implemented.

Institutional Controls: A site-wide institutional control was implemented in 2003 by a resolution by the Cherokee County Commission at the request of the EPA with the support of the KDHE. The control eliminated the use of chat mining wastes as surface material for all roads within Cherokee County. This action represents the achievement of a major site-wide institutional control. Additional site-wide controls as feasible, will be sought by the EPA and the KDHE.

VI. FIVE-YEAR REVIEW PROCESS

The five-year review includes an assessment of any newly promulgated or modified requirements of Federal and state environmental laws in addition to an update and evaluation of the effectiveness of response actions conducted, or planned for implementation, at the Site. New laws or requirements are evaluated to determine whether they are applicable or relevant and appropriate requirements with respect to any response actions conducted at the Site, and whether they call into question the protectiveness of any response action selected in any ROD for the Site. The intent of the five-year review process is to evaluate selected remedies at a site and determine if the remedies remain protective of human health and the environment.

The five year review team for the Cherokee County, Kansas Superfund site includes the following individuals: Dave Drake, EPA Project Manager; Bob Richards, EPA Attorney; Venessa Madden, EPA Ecological Risk Assessor; Rob Weber, KDHE Unit Chief; Leo Henning, KDHE Section Chief; and John Miesner, USFWS Biologist. The five year review will be placed in all site

repositories for the Cherokee County Superfund site, as well as the EPA Region 7 office, and its availability will be announced by a public notice in local newspapers. A public notice and fact sheets announcing the start of the five-year review process were released in July 2005.

VII. TECHNICAL ASSESSMENT

The in-place remedies at this Site for OU-1 and OU-7 are considered to be protective and the remedies in progress for OU-6 are expected to be fully protective once implemented. Work at OU-2 is in the pre-remedy characterization phase and thus cannot be evaluated for remedy effectiveness at this time.

The in-place remedies at this Site for OU-3, OU-4, and OU-5 are not considered to be fully protective and the institutional controls components of all remedies are not fully implemented or protective at this time. The following sections discuss the followup actions that are necessary to achieve protectiveness.

The technical assessment involves an analysis of the following three basic questions regarding each completed remedy: is the remedy functioning as intended by the decision documents; are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid; and has any other information come to light that could call into question the protectiveness of the remedy.

As mentioned above, there are three operable units (OU-3, OU-4, and OU-5) that do not meet all of the three question criteria in the affirmative. These three operable units will be discussed below in regard to the three technical questions comprising the technical assessment.

Question A: Is the remedy functioning as intended by the decision documents?

The remedies at OU-3 and OU-4 are functioning as intended by the decision documents. The majority of the remedy at OU-5 is functioning; however, the cost of maintaining the functionality has possibly exceeded expectations and certain portions of the remedy, estimated at less than 20 percent, are not fully functional due to maintenance, or possible design, issues.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

Some exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy are no longer valid for OU-3, OU-4, and OU-5. The OU-3 remedy did not address all surficial mining wastes and the OU-4 remedy did not address any surficial mining wastes. The rationale for the historic OU-3 approach entailed a cost-benefit analysis that resulted in achieving maximum environmental gains at a cost savings by only addressing the major contributing sources of mining wastes to surface water bodies. The OU-4 rationale was based on consistency with actions performed by EPA Region 6 and the state of Oklahoma due to the geographic nature of the

environmental problem that bisects regional and state boundaries. The OU-5 remedy did not include a parcel of surficial mining wastes associated with the former smelter operation.

The historic decisions to leave mining wastes at the surface in some locations did not fully consider the potential future exposure and toxicity to human and ecological receptors. The protection of human receptors is based on implementation of an institutional controls program that has not been fully implemented to date. As a result of this situation, there have been three documented instances of families re-locating to mine waste areas at OU-4. This resulted in the need to test these properties and the results indicated that one property must be remediated. Moreover, some children residing in two of the three households have a documented exceedance of a blood lead level greater than 10 ug/dl. There are also no controls to prohibit the unauthorized taking and use of the mine waste materials for inappropriate purposes such as residential applications. Toxic tort lawsuits by families with impacted children have occurred in the Oklahoma portion of the Tri-State Mining District since the last five-year review. These legal actions and environmental harm to children are a result of un-remediated mining wastes in that area. There is a possibility of this situation occurring in other locations with existing mining wastes. While Cherokee County, Kansas has implemented a facet of the institutional controls program by prohibiting the use of mine waste materials for surface roads, this control does not fully address the potential human exposure routes. Complete physical removal or remediation of all surficial mining wastes, an engineering solution, is now deemed as the only acceptable method of solving the issues with human health exposures. The criteria in Question B relied heavily upon institutional controls for un-remediated mining wastes at the time of the remedies for protection of human health. Institutional controls have not proven to be fully effective in meeting the expected goals.

The historic decisions also did not fully consider the potential ecological impacts. Mining wastes at the surface continue to be subjected to weathering processes and are being deposited in local stream systems. This continuing situation is problematic for the potential future remediation of receiving streams. All wastes contributing to feeder streams must be remediated prior to performing any cleanup actions in the receiving streams in order to avoid re-contamination of the primary streams. Moreover, mining wastes at the surface are available for uptake by ecological receptors and represent a continuing threat.

While it is true that a significant portion of the problem, in terms of human health and ecological risk, has been addressed by the remediation of approximately 1,200 acres of mining wastes at OU-3 and OU-5, the remaining acreages of surficial wastes at OU-3, OU-4, and OU-5 must be fully remediated in order to achieve protectiveness. Institutional controls only have the ability to protect human health, ecological receptors are not protected by any institutional controls program, and human receptors are not currently protected since the controls are not fully implemented. Engineering solutions are the desired approach to achieve permanence and fully protect both ecological and human receptors.

The state of Oklahoma and EPA Region 6 have begun efforts to characterize and remediate mining wastes at the Tar Creek site. The state of Oklahoma has remediated mine waste areas at the Tar Creek site and EPA Region 6 is engaged in an RI/FS for mining wastes. The University of Oklahoma

has conducted many pilot studies and actions inclusive of engineered wetlands. The U.S. Army Corps of Engineers completed a watershed plan for Tar Creek and Spring River and an Oklahoma Governor's task force released a series of studies, reports, and recommendations related to remediating the Tar Creek site. Additionally, these agencies and others have joined a multi-state, multi-organizational effort aimed at characterizing and addressing impacts to Tar Creek and Spring River. These actions are in marked contrast to the situation during the last five-year review and at the time of the OU-3, OU-4, and OU-5 remedies at the Cherokee County site. The historic decision to defer a surficial mine waste clean-up at the Treece subsite (OU-4) was based on complimentary actions taken by EPA Region 6 and the state of Oklahoma with provisions for modifying the approach in a joint effort to solve the environmental issues that transcend regional and state boundaries. The new approach in EPA Region 6 and Oklahoma necessitates a complimentary approach in EPA Region 7 and Kansas as well as the state of Missouri. These policy and programmatic changes, in addition to new scientific information, represent a strong case for addressing all mining wastes at the Site.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Additional information has become available since the last five-year review to call into question the protectiveness of the remedies at OU-3, OU-4, and OU-5. Bird toxicity from exposure to mining wastes, or mining impacted media (water, sediment, etc.), has been examined and reported in scientific articles since the last five-year review. Zinc toxicosis has been documented in wild birds collected at the Site and the scientific findings indicate that the District is the only likely location with sufficient zinc concentrations capable of causing the observed effects. These studies have shown zinc toxicity to avian species that had been unreported in the past.

Additionally, recent information also indicates possible localized impacts to horses and other domesticated livestock. A deceased colt from the OU-4 area was examined by a local veterinarian and the findings indicated possible heavy metal impacts/interactions from mining wastes or mining-impacted media was the likely cause of death. Other horses at OU-4 are undergoing treatment for effects thought to be a result of mining impacts. The EPA is currently evaluating this situation.

The state of Kansas has established total maximum daily loads (TMDLs) for the Spring River basin that seek to control and minimize impacts to the basin. Unremediated mining wastes serve as a continual loading source of heavy metals to the basin and are a detriment to the TMDL criteria.

Moreover, mussel studies have been released since the last five-year review, and these findings indicate significant impacts to local mussel populations as a result of surficial mine tailings washing into stream systems and impacting the surface water and sediments of these systems. This collective, new, scientific information indicates that the historic ecological risk assessments have underestimated the potential risk in areas of existing mining wastes and mining impacted media. These new findings show the need to fully address all surficial accumulations of wastes in OU-3, OU-4, and OU-5. Table 2 provides a listing of the documents reviewed for this five-year review report.

VIII. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The following recommendations have been identified on an operable unit basis as a result of the third five-year review process for the Cherokee County site. An additional overall follow-up item pertaining to institutional controls for the entire site is also discussed.

OU-1, Galena Alternate Water Supply: No follow-up.

OU-2, Spring River Basin: No follow-up.

OU-3, Baxter Springs subsite: Amend the existing OU-3/OU-4 ROD to expand the mine waste cleanup to include all surficial wastes at the Baxter Springs subsite.

OU-4, Treece subsite: Amend the existing OU-3/OU-4 ROD to expand the mine waste cleanup to include all surficial wastes at the Treece subsite and impacted sediments within Tar Creek.

OU-5, Galena Groundwater/Surface Water: Amend the existing OU-5 ROD to add an additional cleanup area (former smelter grounds) that was omitted from the initial ROD. Additionally, the KDHE will complete a detailed assessment of the existing, completed remedy with regard to the extent, cost, and scope of ongoing O&M activities inclusive of any recommendations for remedy enhancement in select areas.

OU-6, Badger, Lawton, Waco, and Crestline subsites: No follow-up.

OU-7, Galena Residential Soils: No follow-up.

Institutional controls aspects are woven into all of the remedial actions at the Site. The institutional controls program will be a county-wide effort that is applicable to each operable unit. Some aspects of the institutional controls program have been implemented but all components of the work are not established at this time and the full program has not been implemented. Controls on new development in mine waste areas should be established as a general follow-up recommendation resulting from this five-year review.

Prior Five-Year Review Follow-up

The prior five-year review recommended follow-up actions for OU-1, OU-4, OU-5, and OU-7. These items are discussed below on an operable unit basis.

OU-1, Galena Alternate Water Supply: The prior report recommended an evaluation of pumping operations at the OU-1 rural water district to ensure that adequate water supplies continue to be available due to the construction of new pumping wells located in close proximity to the existing water supply wells of the rural water district. The rural water district informed the EPA that the available quantity and elevation of groundwater remain sufficient for optimum operation of the rural water district.

OU-4, Treece subsite: The prior review recommended a continuing dialogue with EPA Region 6 and Oklahoma regarding mine waste cleanup plans in the Tar Creek basin. Additionally, the report recommended the continued assessment of the effectiveness of the completed OU-4 remedy. This effort was completed and is documented in many portions of the current 2005 five-year review report.

OU-5, Galena Groundwater/Surface Water: The prior review recommended including the results of a biological study of the OU-5 area into the next report and also discussing efforts in establishing TMDLs for Site streams. The TMDL recommendation also applied to OU-4 and they have been established for the Spring River basin and discussed in this report. The biological study results were also referenced in this report.

OU-7, Galena Residential Soils: The prior report recommended including the findings of a blood lead follow-up study in the community of Galena, Kansas in the next five-year review report. The results of this study have been included in this report.

Institutional Controls were also mentioned as an item to discuss in the next report in terms of progress and status. The current report contains that information.

IX. PROTECTIVENESS STATEMENTS

The protectiveness aspects of response actions conducted at operable units of the Cherokee County site are described below. Protectiveness cannot be assessed at all operable units since the Site is currently not at construction completion. Additionally, the site-wide institutional controls program is not fully implemented and thus cannot be assessed at this time. Construction completion is tentatively expected to occur in 2015.

OU-1, Galena Alternate Water Supply

The rural water district has supplied safe drinking water to rural residents in the Galena area for approximately eleven years. The system continues to expand by adding new hookups to more residences. The remedy remains protective and continues to be operational and functional. Human health threats associated with consuming metals-contaminated, shallow groundwater from private wells have been alleviated by the provision of a safe drinking water source.

OU-2, Spring River Basin

The Kansas and Missouri portions of the Spring River basin are expected to be protected as a result of future response actions implemented at the Cherokee County, Kansas and Jasper County, Missouri Superfund sites. All necessary response actions are not completed at this time. Potential future enforcement, under the Clean Water Act or other statutes, against parties not subject to CERCLA liability, would also likely enhance the quality of the Spring River. The ultimate protectiveness of this OU cannot be assessed until all response actions have been completed and sufficient time has transpired to allow a scientific evaluation of new monitoring data as contrasted to historic results.

Environmental impacts to the Spring River basin are currently being characterized in preparation for future cleanup decisions.

OU-3, Baxter Springs subsite

The completed remedy is partially protective of human health and the environment. All impacted residential areas were tested and remediated thus alleviating metals uptake from residential soils; however, while the majority of surficial mining wastes were also remediated, there are additional accumulations of wastes that have not been addressed and institutional controls are not in place to restrict new development in these areas. Additionally, any institutional controls enacted in the future for existing mine waste accumulation areas will not be protective of ecological receptors.

The major accumulations of mining wastes contributing to the contamination of surface water bodies were stabilized and thus provide a large measure of ecological protectiveness; however, this protectiveness is not fully complete due to the continued presence of lesser accumulations of un-remediated surficial mining wastes. Metals loading to surface water bodies, the groundwater system, and erosion of wastes has been significantly reduced upon remedy completion but has not been alleviated. The primary contributing mine waste accumulations, from a metals loading perspective, have been addressed by the remedy; however, the additional remaining mine wastes must also be addressed in order for the remedy to be fully protective of human health and the environment.

OU-4, Treece subsite

The completed remedy is partially protective of human health and the environment. All impacted residential areas were tested and remediated thus alleviating metals uptake from residential soils; however, no surficial mining wastes were addressed by the remedy and institutional controls are not in place to restrict new development. A total of three new residences have been located in mine waste areas following the completion of the residential remedy in 2000. One of these properties requires cleanup. Moreover, any institutional controls enacted in the future will only address human receptors to some degree and will not be protective of ecological receptors.

Ecological receptors and any potential mine waste erosion or importation to residential areas have not been adequately addressed by the OU-4 remedy. The Treece remedy consisted of a residential cleanup action; mining wastes in non-residential areas were not addressed based upon a technical impracticability waiver of surface water criteria. Potential mine waste erosion or impacts to the completed remedy were deemed not to be a major concern during remedy selection since the primary cause of the residential contamination was thought to be the importation of mining wastes as fill and driveway material as opposed to erosion. However, the lack of institutional controls has permitted new development (three residences) in the un-remediated mine waste areas of Treece.

Ecological impacts were not addressed based on a technical impracticability approach in concert with an earlier remedial approach taken by the state of Oklahoma and EPA Region 6. Oklahoma, EPA Region 6, Kansas, and EPA Region 7 (Treece subsite) have similar mine waste

impacted areas that are part of the Tar Creek drainage basin. Tar Creek has been classified as a no beneficial use water body by the state of Oklahoma and historic cleanup decisions by Oklahoma and EPA Region 6 have waived surface water criteria for the Tar Creek basin on the basis of technical impracticability. The completed Region 7 cleanup of the Treece subsite also waived surface water criteria based on a technical impracticability approach with support of the state of Kansas. However, the ROD for OU-3/4 has provisions that mandate a re-assessment of the remedy for the ecological impacts if Oklahoma or Region 6 enact changes to the current classification of Tar Creek or re-open the remedy for this portion of the Tar Creek Superfund site.

The state of Oklahoma and EPA Region 6 have begun a characterization effort for the Tar Creek area aimed at a future remedial response. Likewise, Native American Indian tribes and other stakeholders have formed many workgroups and partnerships since 2000 and many diverse characterization and remediation efforts have begun or been completed. In short, the situation in the Tar Creek drainage basin has dramatically changed since 2000. Moreover, new ecological risk studies have demonstrated significant impacts to birds (zinc toxicosis) and mussel populations that were unknown earlier, and relatively new information also shows potential risks to horses. All surficial mine wastes and impacted sediments at the Treece subsite must be remediated in order to achieve protectiveness.

OU-5, Galena Groundwater/Surface Water

The majority of the 900 acres of mining wastes addressed by the cleanup remain effectively vegetated and the majority of the filled shafts and subsidence features remain closed. Erosion of mining wastes and metals-impacted soils to streams has been reduced, leaching of heavy metals to the groundwater system has been reduced, and some degree of ecological improvement has been identified based on the findings of a biological/ecological assessment of the area. Overall, this remedy remains protective and is operational and functional; however, a potential lack of protectiveness may be present in certain areas (steep slopes, highly acidic soils, areas lacking organics) of the cleanup, estimated at less than 200 acres, where mining wastes are subject to erosion and O&M efforts have been costly and potentially excessive. This aspect of the completed OU-5 remedy requires an evaluation.

Surficial mine wastes in the former smelter area were not addressed by the OU-5 remedy; thus, as is the case at OU-3 and OU-4 described above, these wastes are available to impact ecological receptors and are also washing into surface water (Short Creek). Short Creek ultimately drains to the Spring River discussed in OU-2. The completed OU-5 remedy is thus only partially protective of human health and the environment.

OU-6, Badger, Lawton, Waco, and Crestline subsites

Protectiveness cannot be assessed at this operable unit since the remedy has not been completed. This OU is in the RD/RA negotiation phase with the PRPs. It is anticipated that the remedial approach selected at these subsites, embodied in the 2004 ROD, will be protective of human health and the environment since the future cleanup requires that all surficial mining wastes in the OU-6 subsites be addressed.

OU-7, Galena Residential Soils

This remedy is complete and has been shown to be protective based on the results of a 2004 ATSDR study. Over 700 residential properties were remediated and the follow-up blood lead study has shown a 44.6 percent drop in geometric blood lead levels of children less than six years of age as contrasted with blood lead levels measured prior to conducting the remedial action. The geometric mean of Galena children following the cleanup (2.29 ug/dl) is essentially equivalent to the United States average of 2.2 ug/dl reported in 1999-2000.

X. NEXT REVIEW

Since hazardous substances, pollutants, or contaminants remain at the Site at levels above cleanup standards in certain locations, and all areas of the Site have not yet been addressed or have been addressed and do not allow for unlimited use, EPA will conduct additional statutory five-year reviews. The next five-year review will be completed by September, 2010.

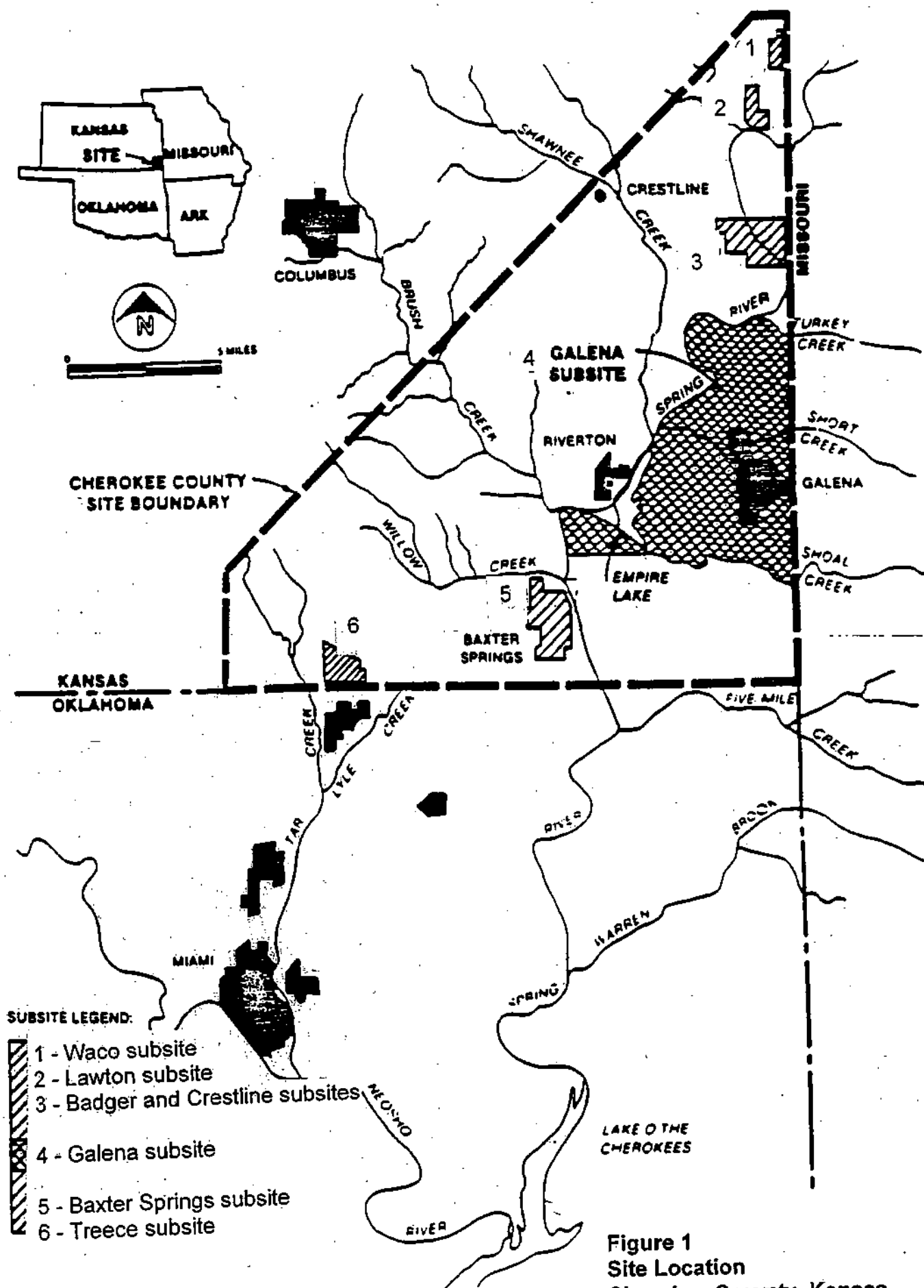


TABLE 1 - SITE CHRONOLOGY

<u>Event</u>	<u>Date</u>
Site added to National Priorities List	1983
OU-1 Removal Actions Complete	1987,1988, 1991
OU-1 ROD	1987
OU-5 ROD	1989
OU-1 Remedial Action Complete	1994
First Five-Year Review	1995
OU-7 Removal Action Complete	1996
OU-5 Remedial Action Complete	1995
OU-7 ROD	1996
OU-3 and OU-4 ROD	1997
OU-4 Remedial Action Complete	2000
Second Five-Year Review	2000
OU-7 Remedial Action Complete	2001
OU-3 Remedial Action Complete	2004
OU-6ROD	2004
OU-2 Characterization	2004-2005
Third Five-Year Review	2005

TABLE 2 - LISTING OF DOCUMENTS REVIEWED

Agency for Toxic Substances and Disease Registry, 2004. Follow-up Study to Investigate Blood Lead Levels in Children in Galena, Kansas. Kansas Department of Health and Environment, Topeka, KS.

Angelo, R. T. et. al., 2005. Residual Effects of Lead and Zinc Mining on Freshwater Mussels (Molluska: Unionidae) in the Spring River Basin. Abstracts of the Tri-State Mining District Forum, Missouri Southern State College, Joplin, MO.

Beyer, W. N., 2005. Zinc and Lead Poisoning in Wild Birds in the Tri-State Mining District. Abstracts of the Tri-State Mining District Forum, Missouri Southern State College, Joplin, MO.

Beyer, W. N. et. al., 2004. Zinc and Lead Poisoning in Wild Birds in the Tri-State Mining District (Oklahoma, Kansas, and Missouri). Journal of Environmental Contamination and Toxicology.

Gunter, J. and V. Madden, 2005. Framework for the Ecological Assessment of Impacted Sediments at Mining Sites in Region 7. Abstracts of the Tri-State Mining District Forum, Missouri Southern State College, Joplin, MO.

Ingersoll, C. and D. MacDonald, 2005. Development and Application of Empirically-Derived Sediment Quality Guidelines. Abstracts of the Tri-State Mining District Forum, Missouri Southern State College, Joplin, MO.

Joplin Globe, 2005. Heavy Metals Degrade Streams. Article by Wally Kennedy, Joplin, MO.

Joplin Globe, 2005. Study Finds Metals in Area Lakes. Article by Wally Kennedy, Joplin, MO.

Joplin Globe, 2005. Heavy Metals Poisoning Birds. Article by Wally Kennedy, Joplin, MO.

Kansas Department of Health and Environment, 2003. 2002-2003 Maintenance Project, Cherokee County Superfund Site, Galena Subsite OU-5, Galena, Kansas.

Kansas Department of Health and Environment, 2002. Repair Work, Cherokee County Operable Unit #5, Galena Groundwater/Surface Water Operable Unit, Galena, Kansas.

Kansas Department of Health and Environment, 2002. Cherokee County Operable Unit #5, Galena Groundwater/Surface Water Repair Estimate, Galena, Kansas.

Kansas Department of Health and Environment, 2000. Use Attainability Analysis (UAA) for Cherokee County.

Kansas Department of Wildlife and Parks, 2000. Recovery Plan for Four Freshwater Mussels in Southeast Kansas. Stream and Prairie Research, Eureka, KS.

MacDonald et. al., 2000, Consensus-Based Threshold Effects Criteria (TEC) for Freshwater.

Miami News-Record, 2005. Superfund Cleanup Investigation of Tar Creek Sediment in Oklahoma. Miami, OK.

Novak, A. et. al., 2005. Zinc Phytotoxicity and Natural Resource Damage Assessment in the Tri-State Mining Region USA. Abstracts of the Tri-State Mining District Forum, Missouri Southern State College, Joplin, MO.

Nairn, R., 2005. Passive Treatment Mine Seeps. Abstracts of the Tri-State Mining District Forum, Missouri Southern State College, Joplin, MO.

Oklahoma Department of Environmental Quality, 2000. Summary Report of Washed and Unwashed Mine Tailings (Chat) from the Tar Creek Superfund Site Area. Oklahoma, City, OK.

Pope, L. M. et. al., 2005. Assessment of Trace Elements in Sediment in the Spring River/Empire Lake and Tar Creek Systems, Southeast Cherokee County, Kansas. Abstracts of the Tri-State Mining District Forum, Missouri Southern State College, Joplin, MO.

Schmitt, C. J. et. al., 2005. Bioavailability of Metals from Mining and Effects on Aquatic Organisms. Abstracts of the Tri-State Mining District Forum. Missouri Southern State College, Joplin, MO.

Sileo, L. et. al., 2004. Pancreatitis in Wild Zinc-Poisoned Waterfowl. Journal of Avian Pathology (12/04, 32(6), 655-660).

Stiles, T., 2005. Kansas Spring River Metal TMDLs. Abstracts of the Tri-State Mining District Forum, Missouri Southern State College, Joplin, MO.

State of Kansas, 2005. Total Maximum Daily Load Determinations for the Spring River Basin. Topeka, KS.

State of Oklahoma, 2000. Symposium on Chat Usage and Regulations. Miami Civic Center, Miami, OK.

The Oklahoman, 2005. Zinc Poisoning, Tar Creek Site - Tar Creek Birds Suffer Poisoning. Oklahoma City, OK.

Tulsa World, 2005. Study Finds Metals in Area Lakes. Tulsa, OK.

U.S. Army Corps of Engineers, 2004. Tar Creek and Lower Spring River Watershed Plan. Tulsa District, Tulsa, OK.

U.S. EPA Region 6, 2005. Fact Sheet for Tar Creek Sediment, OU-5, and Tri-State Watershed Map. Dallas, TX.

U.S. EPA Region 7, 2005. Tri-State Mining District Watershed Framework and Map. Kansas City, KS.

U.S. EPA Region 7, 2004. Proposed Plan for Cherokee County Superfund Site, Badger, Lawton, Waco, and Crestline Subsites, Operable Unit # 06 - Cherokee County, Kansas. Memo from Venessa Madden to Dave Drake.

U.S. EPA Region 7, 2004. Ecological Preliminary Remediation Goals for Cadmium, Lead, and Zinc. Memo from Venessa Madden to Gene Gunn.

U.S. EPA Region 7, 1987, 1989, 1996, 1998, and 2004. Records of Decision for OU-1, OU-5, OU-7, OU-3/4, and OU-6 for the Cherokee County Superfund Site, Cherokee County, Kansas.

U.S. EPA Region 7, 1995 and 2000. Five-Year Review Reports for the Cherokee County Superfund Site, Cherokee County, Kansas.

U.S. EPA Region 7, 2001. Evaluation of Operation and Maintenance Costs for Operable Unit # 05, Cherokee County, Kansas Superfund Site.

U.S. Fish and Wildlife Service, 2004. Cherokee County Preliminary Assessment Survey. USFWS Region 6 website.

U.S. Fish and Wildlife Service, 2004. Phase I Damage Assessment Plan for Cherokee County, Kansas. USFWS Region 6 website.

U.S. Geological Survey, 2005. Assessment of Continuous Metals Concentrations and Loads in the Spring and Neosho River Basins, Missouri, Kansas, and Oklahoma. Plan submitted to EPA Region 7.

U.S. Geological Survey, 2005. Evaluation of Sediment Quality in the Tri-State Mining District. Plan submitted to EPA Region 7, Kansas City, KS.

U.S. Geological Survey, 2004. Assessment of Metals in Sediment in Empire Lake and Spring River and Tar Creek Systems, Southeast Kansas. Plan submitted to the U.S. Fish and Wildlife Service, Manhattan, KS.

Wildhaber, M. L. et. al., 2000. Natural and Anthropogenic Influences on the Distribution of the Threatened Neosho Madtom in a Midwestern Warmwater Stream. Transactions of the American Fisheries Society (129:243-261).

Appendix 1 - Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name (from WasteLAN): Cherokee County		
EPA ID (from WasteLAN): KSD980741862		
Region: 07	State: KS	City/County: Cherokee
SITE STATUS		
NPL status: <input checked="" type="checkbox"/> Final <input type="checkbox"/> Deleted <input type="checkbox"/> Other (specify) _____		
Remediation status (choose all that apply): <input checked="" type="checkbox"/> Under Construction <input type="checkbox"/> Operating <input type="checkbox"/> Complete		
Multiple OUs? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Construction completion date: ____ / ____ / ____	
Has site been put into reuse? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
REVIEW STATUS		
Lead agency: <input checked="" type="checkbox"/> EPA <input type="checkbox"/> State <input type="checkbox"/> Tribe <input type="checkbox"/> Other Federal Agency _____		
Author name: Dave Drake		
Author title: Remedial Project Manager	Author affiliation: EPA Region 7	
Review period: ** September, 2000 to September, 2005		
Date(s) of site inspection: multiple		
Type of review: <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <input checked="" type="checkbox"/> Post-SARA <input type="checkbox"/> Pre-SARA <input type="checkbox"/> NPL-Removal only </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <input type="checkbox"/> Non-NPL Remedial Action Site <input type="checkbox"/> NPL State/Tribe-lead </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <input type="checkbox"/> Regional Discretion </div>		
Review number: <input type="checkbox"/> 1 (first) <input type="checkbox"/> 2 (second) <input checked="" type="checkbox"/> 3 (third) <input type="checkbox"/> Other (specify) _____		
Triggering action: <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div> <input type="checkbox"/> Actual RA Onsite Construction at OU # _____ <input type="checkbox"/> Construction Completion <input type="checkbox"/> Other (specify) _____ </div> <div> <input checked="" type="checkbox"/> Actual RA Start at OU# 1 <input type="checkbox"/> Previous Five-Year Review Report </div> </div>		
Triggering action date (from WasteLAN): September, 1989		
Due date (five years after triggering action date): September, 1994 (1995 actual), September, 2000 and 2005.		

* ["OU" refers to operable unit.]

** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

Mining wastes are present in OU-3, OU-4, and OU-5 with no existing plans for remediation. Scientific, risk, remedy implementation/maintenance, and policy information generated since the last five-year review call into question the historic remedial approaches that did not fully remediate all mining wastes in these operable units.

Recommendations and Follow-up Actions:

Amend the existing decision documents for OU-3, OU-4, and OU-5 to fully address all mining wastes within these operable units. A single Record of Decision (ROD) covers OU-3/4 and another ROD covers OU-5.

Protectiveness Statement(s):

The remedies at OU-3, OU-4, and OU-5 are not fully protective because mining wastes are present to varying degrees in each area and there are no existing plans to remediate these wastes. All mining wastes must be cleaned up in order to ensure protectiveness in these operable units.

Other Comments:

This recommended approach is consistent with recent actions being planned or undertaken by other agencies in the Tri-State Mining District of Kansas, Missouri, and Oklahoma.